Claims

What is claimed is:

1.   A computerized method for mixing inks to facilitate high fidelity color reproduction for printing, the method comprising the steps of:

computing a first color space using a forward printer model and a first colorant space, with the first color space having no black ink values from the first colorant space, thereby establishing a relationship between the first color space and the first colorant space;

computing a second colorant space using the forward printer model wherein each point in the second colorant space has one corresponding point in the first color space;

computing a second color space using the forward printer model and CMYK ink values;

computing a third color space by comparing the second color space to the first color space to determine which color points in the first color space require black ink;

computing a third colorant space using the printer model and the third color space, wherein each point in the third colorant space has a corresponding point in the third color space;

computing a fourth color space by calibrating and correcting the third color space;

linking the fourth color space with the third colorant space using the forward printer model, wherein each point in the fourth color space has a corresponding point in the third color space; and

forming a color reproduction table using the fourth color space and the third colorant space, for receiving a data input and providing a colorant output for use

25   in mixing inks for high fidelity printing.

2.   A method for mixing inks according to claim 1 wherein the step of computing a first color space includes using a Neugebauer printer model to calculate CIELAB color values to form the first color space, with a CIELAB color value being calculated for each colorant point in the first colorant space based on at least one predetermined measurement.

3.   A method for mixing inks according to claim 2 wherein the steps of calculating CIELAB color values includes sampling each ink at seventeen substantially evenly spaced points over the range from 0-100% ink.

4.   A method for mixing inks according to claim 1 wherein the step of computing a second colorant space includes the step of removing redundant colorant points including certain multiple colorant points to which a single color point corresponds, the removal step including defining a removal grade for each colorant

30   point linked with a common color point and retaining the colorant points with the smallest removal grade for each color point in the first color space, with the second colorant space resulting from the removal of the redundant colorant points.

5.   A method for mixing inks according to claim 1 wherein the step of computing a second color space includes the steps of preparing a mixed CMYK colorant space and inputting every point in the mixed CMYK colorant space into the model to compute the second color space.

6.   A method for mixing inks according to claim 1 wherein the step of computing a third color space includes the steps of comparing the first color space to

the second color space to determine the black ink values necessary for addition to the first color space to form the third color space.

7. A method for mixing inks according to claim 1 wherein the step of computing a third colorant space includes the step of correlating points in the third color space with points in the second colorant space using the printer model to form the third colorant space.

8. A method for mixing inks according to claim 1 wherein the step of computing a fourth color space includes the step of sampling the third color space for calibration, and comparing an actual color value from the third color space with a theoretical color value from the model.

9. A method for mixing inks according to claim 8 wherein the step of computing a fourth color space includes the step of correcting color point values found to be out of tolerance to form a fourth color space having calibrated and corrected values from the third color space.

10. A method for mixing inks according to claim 1 wherein the step of linking the fourth color space includes correlating the fourth color space point values with the third colorant space values.

11. A method for mixing inks according to claim 1 wherein the step of forming a color reproduction table includes the step of inverting the relationship between the third colorant space and the fourth color space to instill the ability to receive as input a given color value and to emit as output a corresponding colorant value.

12. A method for mixing inks according to claim 11 wherein the step of forming a color reproduction table includes the step of computing a colorant value for

each color value to form the color reproduction table includes using a tetrahedral linear interpolation.

13. A printer driver computer software product embodied in a computer readable medium for controlling ink mixing to facilitate high fidelity color reproduction for printing, the software product comprising:

a color reproduction table that accepts image data as input and emits colorant combinations for use by the printer to mix inks to achieve high fidelity color printing, the color reproduction table being formed by:

computing a first color space using a forward printer model and a first colorant space, with the first color space having no black ink values from the first colorant space, thereby establishing a relationship between the first color space and the first colorant space;

computing a second colorant space using the forward printer model wherein each point in the second colorant space has one corresponding point in the first color space;

computing a second color space using the forward printer model and CMYK ink values;

computing a third color space by comparing the second color space to the first color space to determine which color points in the first color space require black ink;

computing a third colorant space using the printer model and the third color space, wherein each point in the third colorant space has a corresponding point in the third color space;

computing a fourth color space by calibrating and correcting the third color space;

27

25   linking the fourth color space with the third colorant space using the forward printer model, wherein each point in the fourth color space has a corresponding point in the third color space; and

forming the color reproduction table using the fourth color space and the third colorant space, for providing a colorant output responsive to a data input for use in mixing inks for high fidelity printing.

30   14.   A printer driver computer software product according to claim 13 wherein the step of computing a first color space includes using a Neugebauer printer model to calculate CIELAB color values to form the first color space, with a CIELAB color value being calculated for each colorant point in the first colorant space based on at least one predetermined measurement.

15.   A printer driver computer software product according to claim 14 wherein the steps of calculating CIELAB color values includes sampling each ink at seventeen evenly spaced points over the range from 0-100% ink.

16.   A printer driver computer software product according to claim 13 wherein the step of computing a second colorant space includes the step of removing redundant colorant points including certain multiple color points to which a single point in the first color space corresponds, the removal step including defining a

5   removal grade for each colorant point linked with the same color point and retaining the colorant points with the smallest removal grade for each color point in the first color space, with the second colorant space resulting from the removal of the redundant colorant points.

17.   A printer driver computer software product according to claim 13 wherein the step of computing a second color space includes the steps of preparing a

mixed CMYK colorant space and inputting every point in the mixed CMYK colorant space into the model to compute the second color space.

18. A printer driver computer software product according to claim 13 wherein the step of computing a third color space includes the steps of comparing the first color space to the second color space to determine the black ink values necessary for addition to the first color space to form the third color space.

19. A printer driver computer software product according to claim 13 wherein the step of computing a third colorant space includes using the printer model to correlate points in the third color space with points in the second colorant space to form the third colorant space.

20. A printer driver computer software product according to claim 13 wherein the step of computing a fourth color space includes the step of sampling the third color space for calibration, and comparing an actual color value from the third color space with a theoretical color value from the model.

21. A printer driver computer software product according to claim 20 wherein the step of computing a fourth color space includes the step of correcting color point values found to be out of tolerance to form a fourth color space having calibrated and corrected values from the third color space.

22. A printer driver computer software product according to claim 13 wherein the step of linking the fourth color space includes correlating the fourth color space point values with the third colorant space values.

23. A printer driver computer software product according to claim 13 wherein the step of forming a color reproduction table includes the step of inverting the relationship between the third colorant space and the fourth color space to instill

the ability to receive as input a given color value and to emit as output a corresponding colorant value.

24. A printer driver computer software product according to claim 23 wherein the step of forming a color reproduction table includes the step of computing a colorant value for each color value to form the color reproduction table includes using a tetrahedral linear interpolation.

25. In an apparatus for printing on a print medium, the improvement comprising:

a preprogrammed control arrangement for controlling ink mixing to facilitate high fidelity color reproduction for printing, the control arrangement

5 including:

means for computing a first color space using a forward printer model and a first colorant space, with the first color space having no black ink values from the first colorant space, thereby establishing a relationship between the first color space and the first colorant space;

10 means for computing a second colorant space using the forward printer model wherein each point in the second colorant space has one corresponding point in the first color space;

means for computing a second color space using the forward printer model and CMYK ink values;

15 means for computing a third color space by comparing the second color space to the first color space to determine which color points in the first color space require black ink;

means for computing a third colorant space using the printer model and the third color space, wherein each point in the third colorant space has a corresponding point in the third color space;

means for computing a fourth color space by calibrating and correcting the third color space;

means for linking the fourth color space with the third colorant space using the forward printer model, wherein each point in the fourth color space has a corresponding point in the third color space; and

means for forming a color reproduction table using the fourth color space and the third colorant space, for providing a colorant output responsive to a data input for use in mixing inks for high fidelity printing.

26.   An improved printing apparatus according to claim 25 wherein the step of computing a first color space includes using a Neugebauer printer model to calculate CIELAB color values to form the first color space, with a CIELAB color value being calculated for each colorant point in the first colorant space based on at least one predetermined measurement.

27.   An improved printing apparatus according to claim 26 wherein the steps of calculating CIELAB color values includes sampling each ink at seventeen substantially evenly spaced points over the range from 0-100% ink.

28.   An improved printing apparatus according to claim 25 wherein the step of computing a second colorant space includes the step of removing redundant colorant points including certain multiple colorant points to which a single color point corresponds, the removal step including defining a removal grade for each colorant point linked with a common color point and retaining the colorant points with the

smallest removal grade for each color point in the first color space, with the second colorant space resulting from the removal of the redundant colorant points.

29. An improved printing apparatus according to claim 25 wherein the step of computing a second color space includes the steps of preparing a mixed CMYK colorant space and inputting every point in the mixed CMYK colorant space into the model to compute the second color space.

30. An improved printing apparatus according to claim 25 wherein the step of computing a third color space includes the steps of comparing the first color space to the second color space to determine the black ink values necessary for addition to the first color space to form the third color space.

31. An improved printing apparatus according to claim 25 wherein the step of computing a third colorant space includes the step of correlating points in the third color space with points in the second colorant space using the printer model to form the third colorant space.

32. An improved printing apparatus according to claim 25 wherein the step of computing a fourth color space includes the step of sampling the third color space for calibration, and comparing an actual color value from the third color space with a theoretical color value from the model.

33. An improved printing apparatus according to claim 32 wherein the step of computing a fourth color space includes the step of correcting color point values found to be out of tolerance to form a fourth color space having calibrated and corrected values form the third color space.

34. An improved printing apparatus according to claim 25 wherein the step of linking the fourth color space includes correlating the fourth color space point values with the third colorant space values.

35.   An improved printing apparatus according to claim 25 wherein the step of forming a color reproduction table includes the step of inverting the relationship between the third colorant space and the fourth color space to instill the ability to receive as input a given color value and to emit as output a corresponding colorant value.

36.   An improved printing apparatus according to claim 35 wherein the step of forming a color reproduction table includes the step of computing a colorant value for each color.